Kentucky Method 64-114-03
Revised 2/11/03
Supersedes 64-114-00
Dated 2/7/00

MEASUREMENT OF CULVERT PIPE DEFLECTION BY MANDREL TESTING, PIPE LINE CAMERA/VIDEO INSPECTION, OR PHYSICAL MEASUREMENTS

1. SCOPE: This method provides three procedures for determining the percent of deflection in culvert pipes: mandrel testing, camera video inspection, and physical measurements.

2. APPARATUS:

   2.1. Mandrel: Use a mandrel device that is cylindrical in shape having 9 possible contact points with the pipe.

   2.2. Camera Testing Equipment: Use a pipe line video inspection camera, a laser light ring projector, frame grabber board and computer. Mount the light ring projector onto and in front of a pipe line video inspection camera.

   2.3. Physical Measuring Tools: Use contact or non-contact distance instruments. This may include tape extensometers, standard folding wooden carpenters tape with a 6-inch slide or a standard retractable metal carpenters tape. The measuring device should be readable to the nearest 1/16-inch.

3. PROCEDURE:

   3.1. Complete the inspection and measurement prior to paving over any pipe. When paving will not be delayed, take measurements 30 days or more after the backfill is completed.

   3.2. Mandrel Testing:

      3.2.1. Use a mandrel with its diameter set to 5% less than the nominal interior diameter (ID) of the pipe being tested. Calibrate the mandrel's diameter by a true circular ring prior to testing, and obtain the Engineer's approval. Clear the invert of the pipe of any debris prior to testing. Pipes with paved inverts will likely require some mandrel modification.

      3.2.2. Shoot, blow, or float a line through the culvert. Attach the tow line and a trailing line to the mandrel for testing. Depending on the mandrel, it may be necessary to keep tension on the trailing line to keep the mandrel from tipping. Pull the mandrel, from the outlet end through the test segment by hand. Do not apply excessive force in pulling the mandrel that may damage the pipe or that may erroneously indicate that deflection was within acceptable limits by temporarily expanding the pipe. The line shall be termed "acceptable" if, during final deflection testing, the mandrel passes completely through the line without restriction. If refusal is encountered on the 5% mandrel, then pull a mandrel measuring 10% less than the nominal ID through the pipe. If refusal is encountered pulling from the outlet end, then repeat the process pulling from the upstream end.

3.2.3. Record the testing information on the data sheet and submit it to the Engineer.

3.2. Pipeline Camera/Video Inspection:

3.3.1. Project the light ring a set distance away from the camera so that the entire ring is in view by the trailing inspection camera. Measure deflection by using a computer and frame grabber card and software. Where deflection is evident, capture the image and use the software to measure the deflection occurring at the point of the projected laser ring.

3.3.2. Calibrate the projected light or laser ring at the start of the inspection. To calibrate a captured image an object of known length must be viewable and in the same plane as the laser ring or the pipe must be physically measured at one location where the ring is projected.

3.3.3. The Engineer will set the required intervals for the deflection measurements to be taken. If higher deflections are observed between the set intervals, then additional measurements shall be taken at these locations. Take the deflection measurements in the vertical (6 to 12 o'clock) and horizontal (9 to 3 o'clock) unless other deflection is noted by the video inspection. Some systems allow for continuous monitoring for deflection in which a preset deflection value such as 5% deflection can be preset into the program.

3.3.4. The benefit of this method is that not only deflection can be measured but also other defects can be noted. These may include vertical and horizontal joint offsets, cracking, spalling, rusting, debris, etc. Include this information with the inspection data sheet and submit to the Engineer along with the video tape.

3.3. Physical Measurements:

3.4.1. Use a contact or non-contact distance instrument. A leveling device is recommended for establishing or verifying vertical and horizontal control.

3.4.2. Physical measurements may be taken (D2) and compared to nominal ID of the pipe after installation. When this method is used, ensure that the measurements are taken through the center point of the pipe. Calculate the deflection as follows:

% Deflection = [(Nominal ID - D2) / Nominal ID] 100%

Note: The Engineer may require that preset monitoring points (D1) be established in the culvert prior to backfilling. The ID of the culvert may then be monitored during the backfill process and after completion of the backfill (D2). Deflection may then be calculated from the following formula:

% Deflection = [(D1 – D2) /D1] (100%)

4. REPORT: Report deflection results to the nearest 0.1 percent on the data sheet.

APPROVED _____
Director
DIVISION OF MATERIALS

DATE _____2/11/03_____

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PIPE LINE DEFLECTION DATA SHEET

Date Tested:

Location Information

District:
County:
Route:
Project No.:
Station:

Culvert and Embankment Information

Pipe Usage (Cross Drain, Storm Drain, Entrance, etc)
Pipe Type and Size:
Culvert Length:
Backfill Type:
Completion Date of Culvert:
Embankment Completion Date:
Final Embankment Height:

Test Data

Deflection Test Method (Mandrel, Camera, Physical):
Maximum Observed Deflection:
Location: